



SOCIETY OF
OUTDOOR
RECREATION
PROFESSIONALS

The Effects of Climate Change on Outdoor Recreation in the United States

December 18, 2019

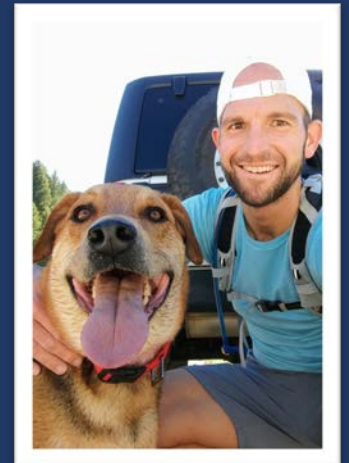


SOCIETY OF
**OUTDOOR
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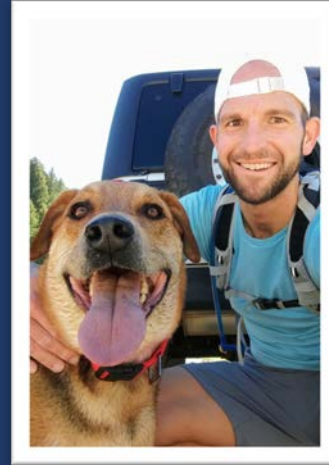


SORP is the voice for advancing the outdoor recreation profession.



SOCIETY OF
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RECREATION
PROFESSIONALS**

TODAY'S PRESENTERS



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SORP is the voice for advancing the outdoor recreation profession.

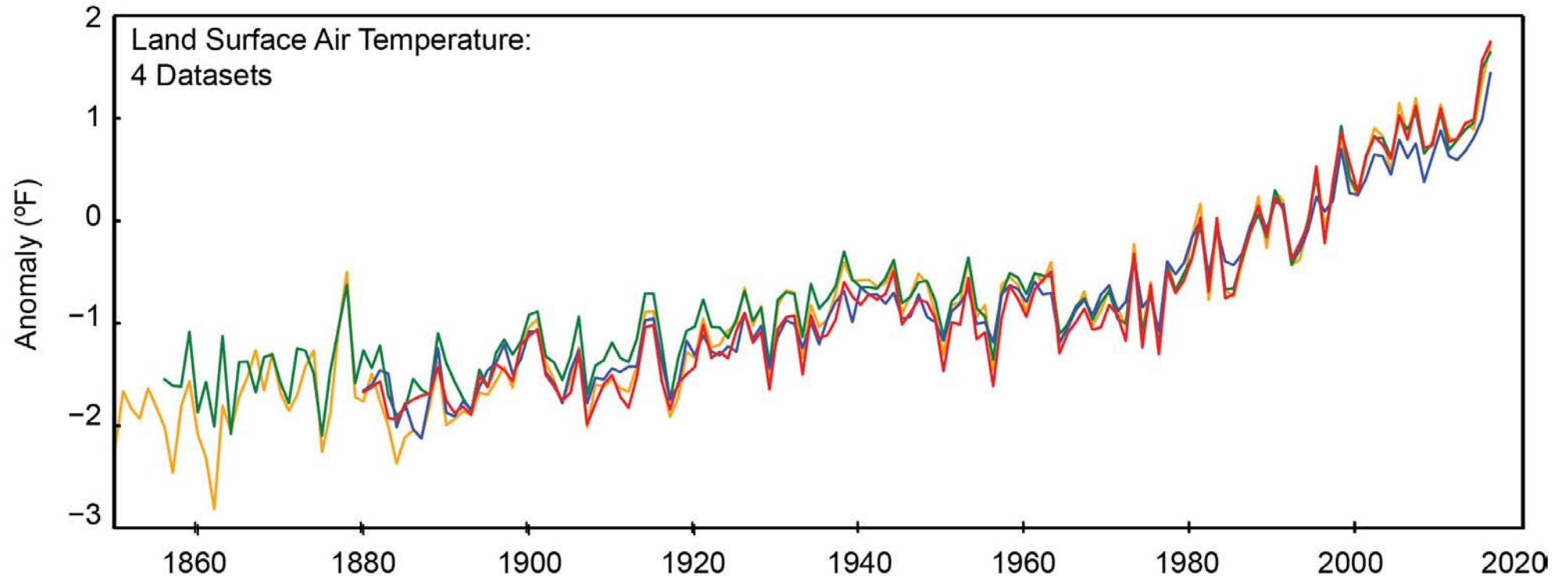
GLOBAL CLIMATE CHANGE

Temperature
- Maximum daily
- Minimum daily

Precipitation
- Amount
- Timing
- Phases

Extreme events
- Wildfires
- Floods
- Droughts
- Hurricanes

Indicators of Warming from Multiple Datasets



GLOBAL CLIMATE CHANGE

Annually-averaged Precipitation Trends

Temperature

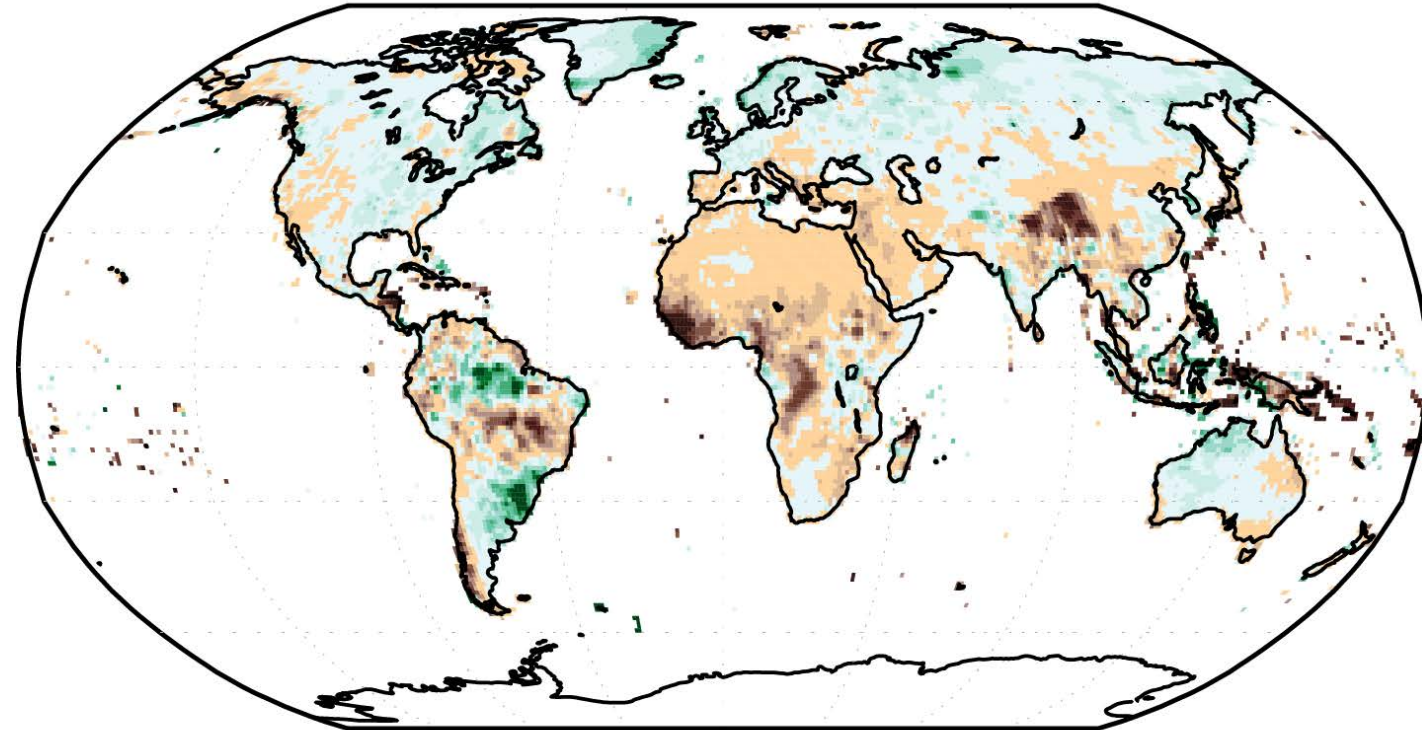
- Maximum daily
- Minimum daily

Precipitation

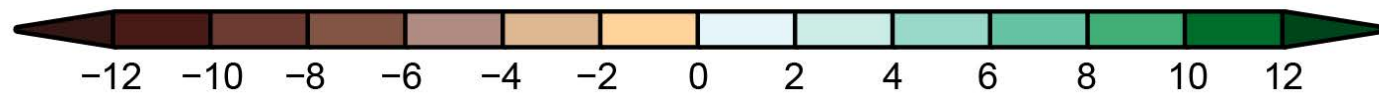
- Amount
- Timing
- Phases

Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes



Change in Precipitation (inches)



GLOBAL CLIMATE CHANGE

Temperature

- Maximum daily
- Minimum daily

Precipitation

- Amount
- Timing
- Phases

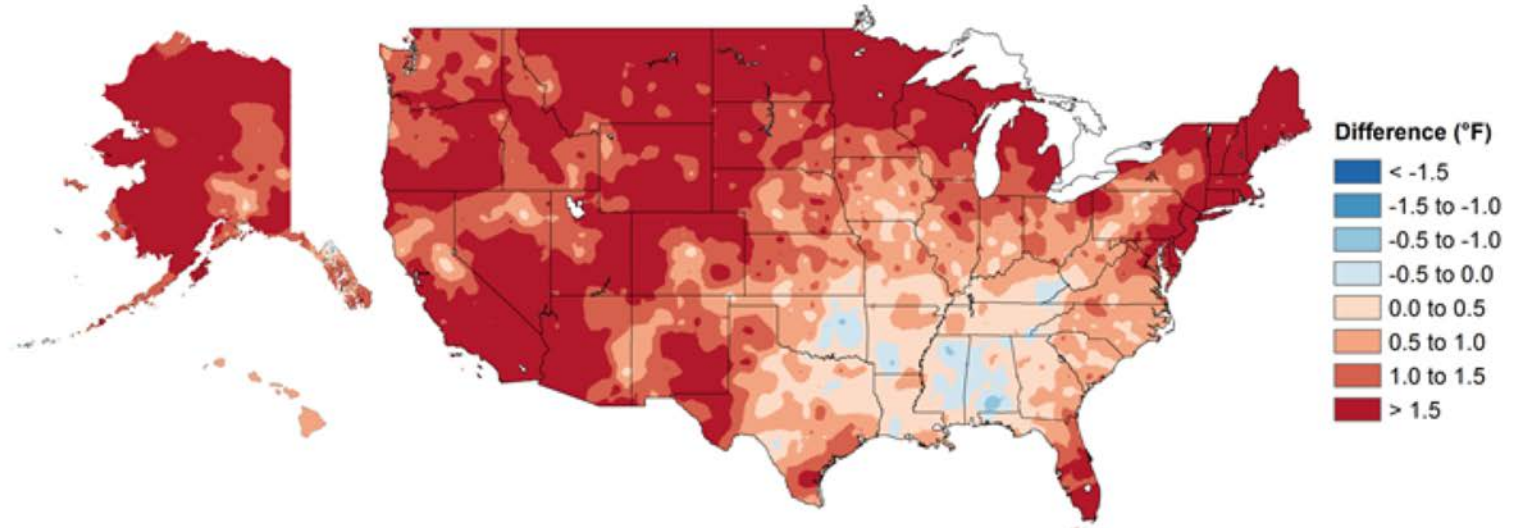
Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes



CLIMATE CHANGE IN THE U.S.

Annual Temperature



Temperature

- Maximum daily
- Minimum daily

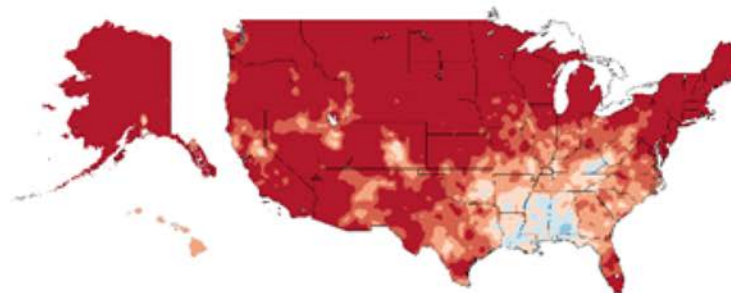
Precipitation

- Amount
- Timing
- Phases

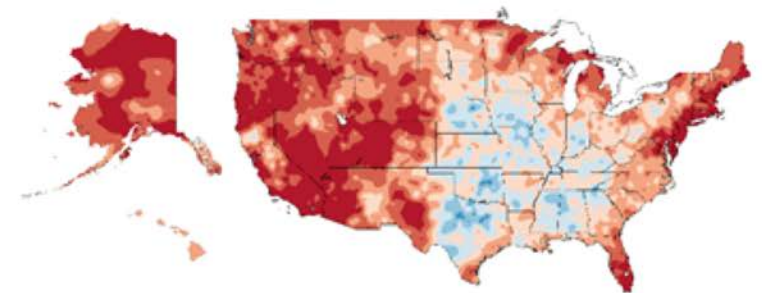
Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes

Winter Temperature



Summer Temperature



OBSERVED

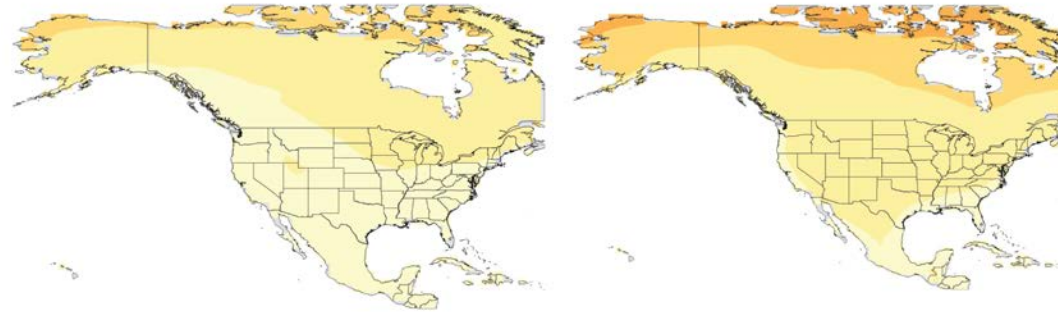
CLIMATE CHANGE IN THE U.S.

Projected Changes in Annual Average Temperature

Mid 21st Century

Lower Scenario (RCP4.5)

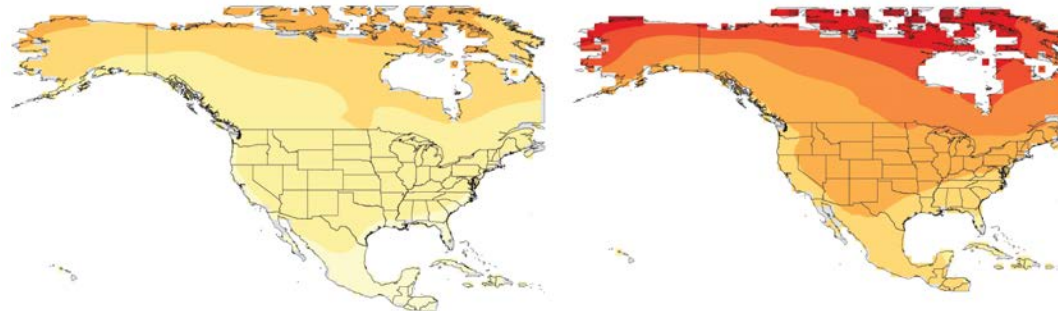
Higher Scenario (RCP8.5)



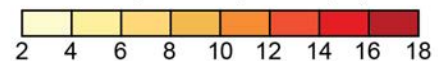
Late 21st Century

Lower Scenario (RCP4.5)

Higher Scenario (RCP8.5)



Change in Temperature (°F)



PROJECTED

Temperature

- Maximum daily
- Minimum daily

Precipitation

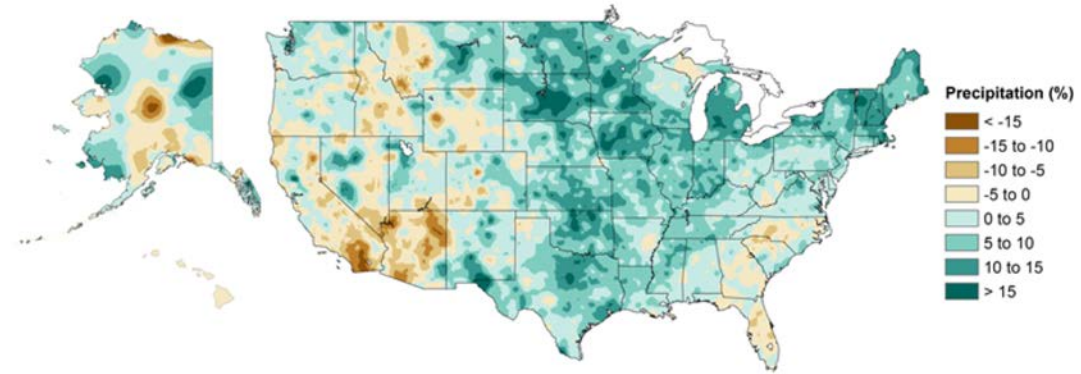
- Amount
- Timing
- Phases

Extreme events

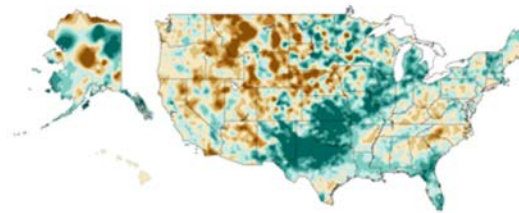
- Wildfires
- Floods
- Droughts
- Hurricanes

CLIMATE CHANGE IN THE U.S.

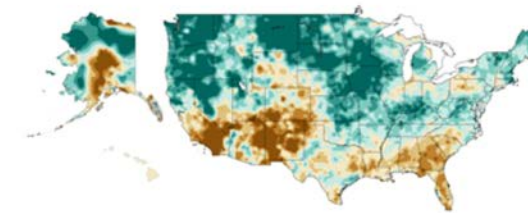
Annual Precipitation



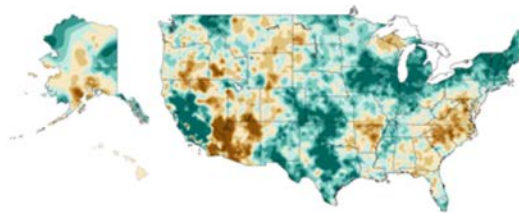
Winter Precipitation



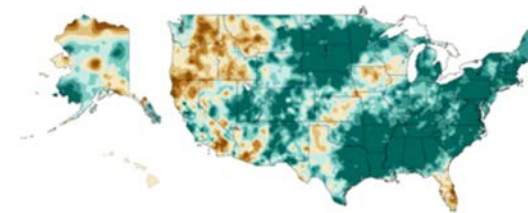
Spring Precipitation



Summer Precipitation



Fall Precipitation



OBSERVED

Temperature

- Maximum daily
- Minimum daily

Precipitation

- Amount
- Timing
- Phases

Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes

CLIMATE CHANGE IN THE U.S.

Temperature

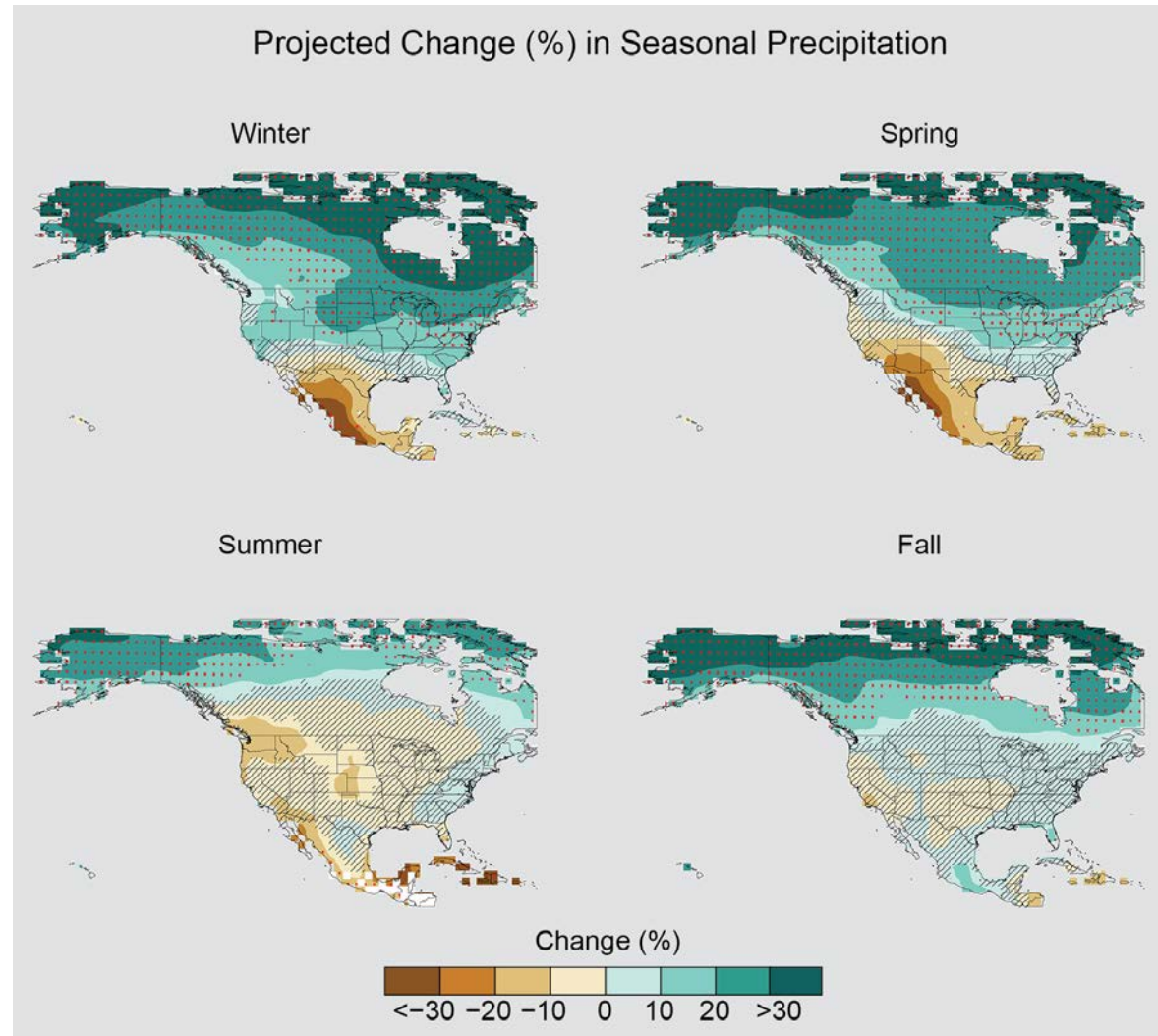
- Maximum daily
- Minimum daily

Precipitation

- Amount
- Timing
- Phases

Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes



PROJECTED

CLIMATE CHANGE IN THE U.S.

Temperature

- Maximum daily
- Minimum daily

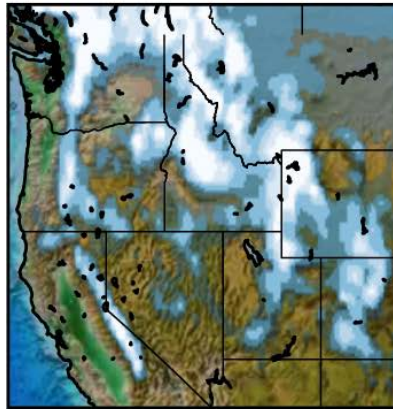
Precipitation

- Amount
- Timing
- Phases

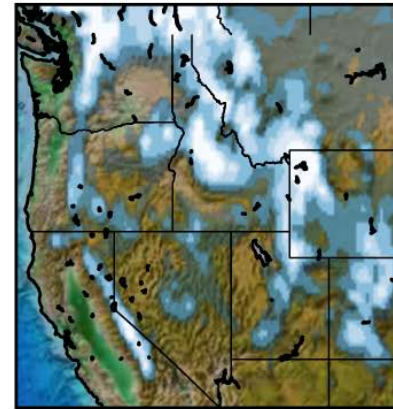
Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes

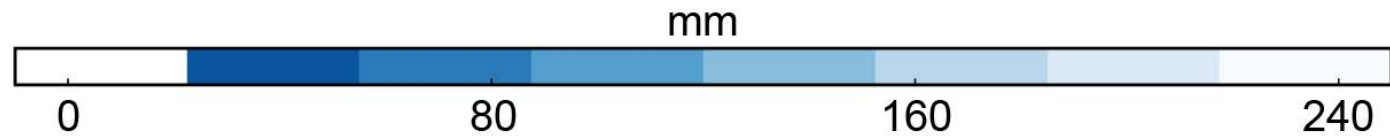
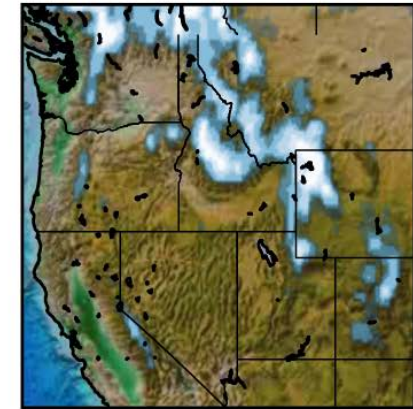
Historical



Mid-Century



End-Century



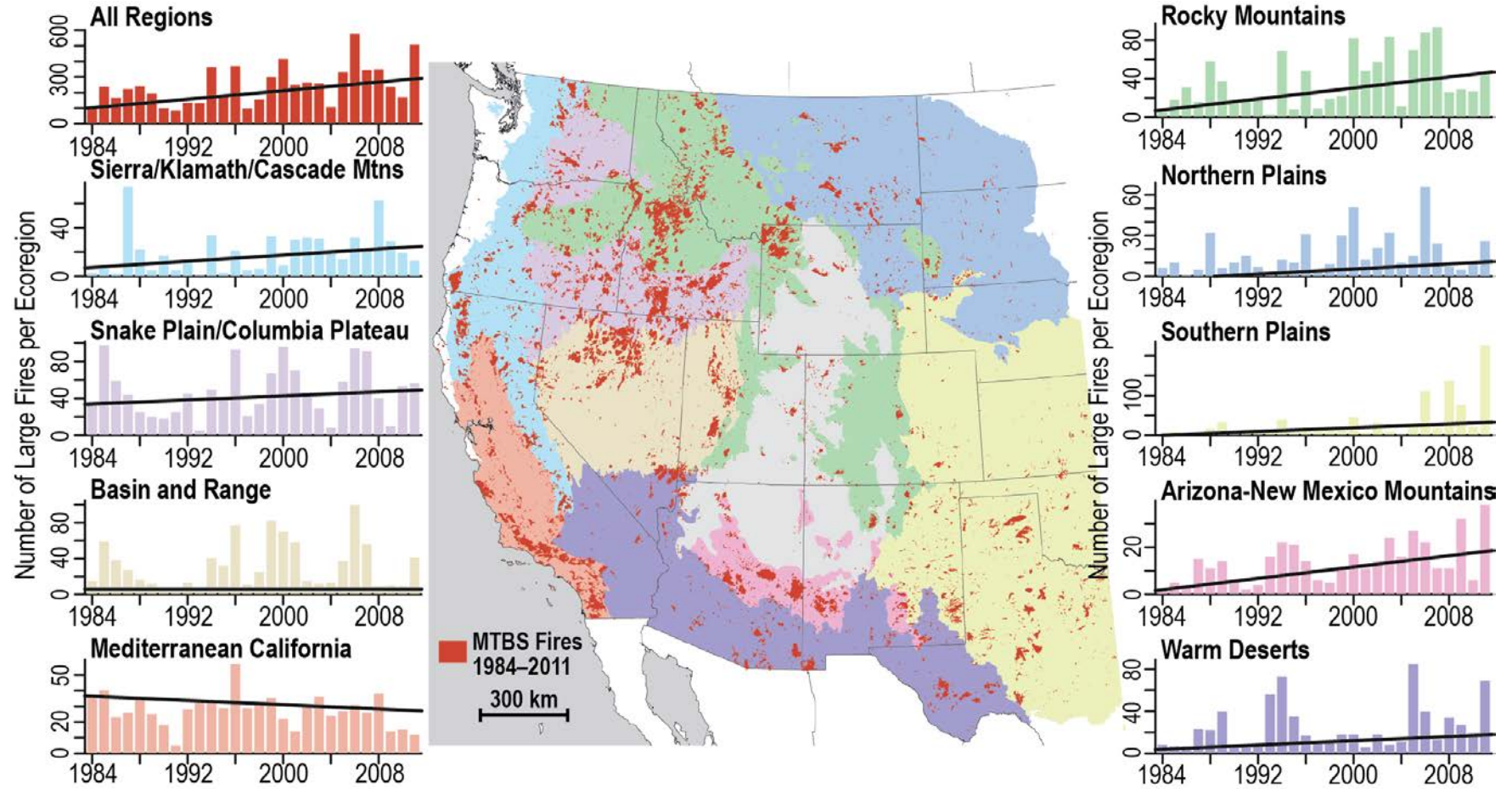
PROJECTED CHANGES IN WINTER MOUNTAIN HYDROLOGY

CLIMATE CHANGE IN THE U.S.

Temperature
 - Maximum daily
 - Minimum daily

Precipitation
 - Amount
 - Timing
 - Phases

Extreme events
 - Wildfires
 - Floods
 - Droughts
 - Hurricanes



PROJECTED CHANGES IN WILDFIRE ACTIVITY

GLOBAL CLIMATE CHANGE

Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes

Precipitation

- Amount
- Timing
- Phases

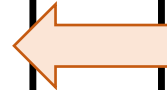
Temperature

- Maximum daily
- Minimum daily



RECREATION DECISIONS

Participation
Activity and site choice
Equipment and investments
Frequency and duration

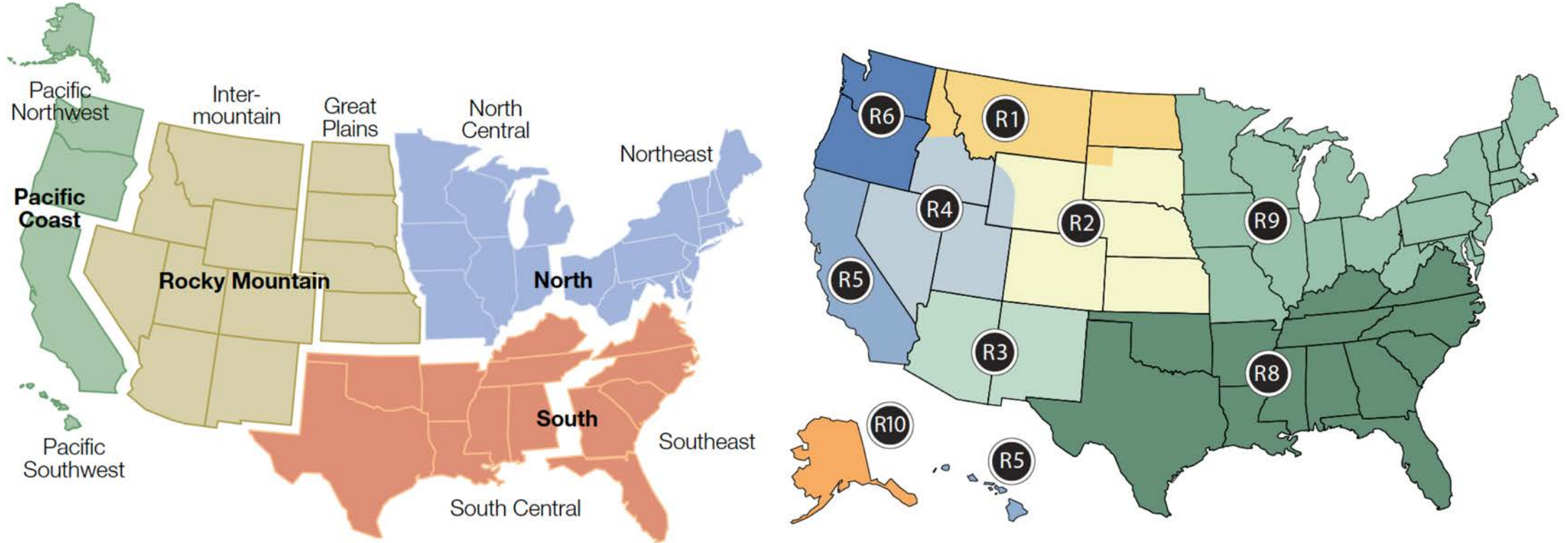


BIOPHYSICAL IMPACTS

Vegetation
Wildlife
Hydrologic dynamics
Disturbance events
Site availability
Unique features (e.g., glaciers)

GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

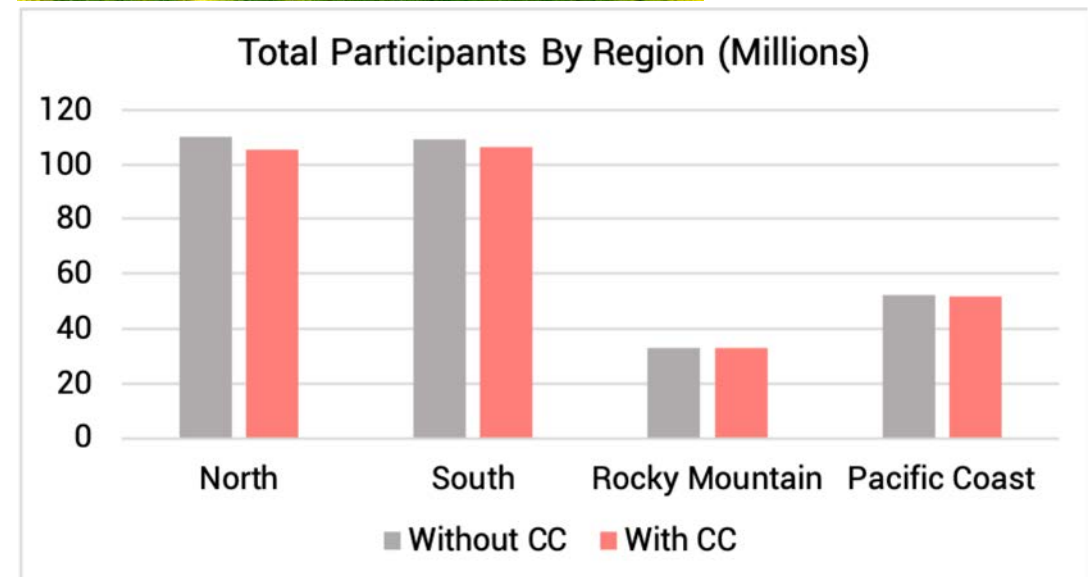
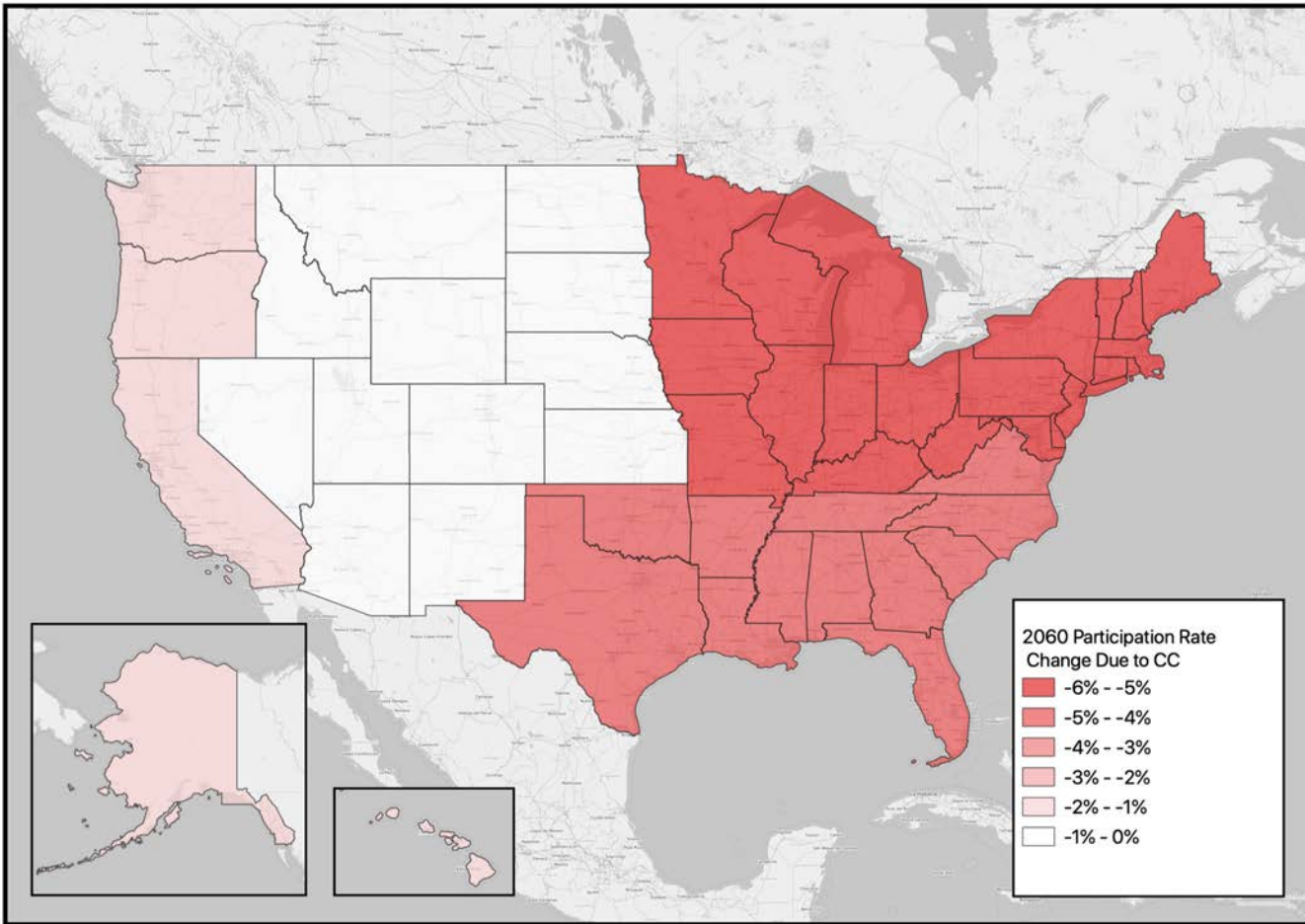
USDA FOREST SERVICE



R1 = Region 1, Northern Region. R2 = Region 2, Rocky Mountain Region. R3 = Region 3, Southwestern Region. R4 = Region 4, Intermountain Region. R5 = Region 5, Pacific Southwest Region. R6 = Region 6, Pacific Northwest Region. R8 = Region 8, Southern Region. R9 = Region 9, Eastern Region. R10 = Region 10, Alaska Region. RPA = Resources Planning Act.

GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

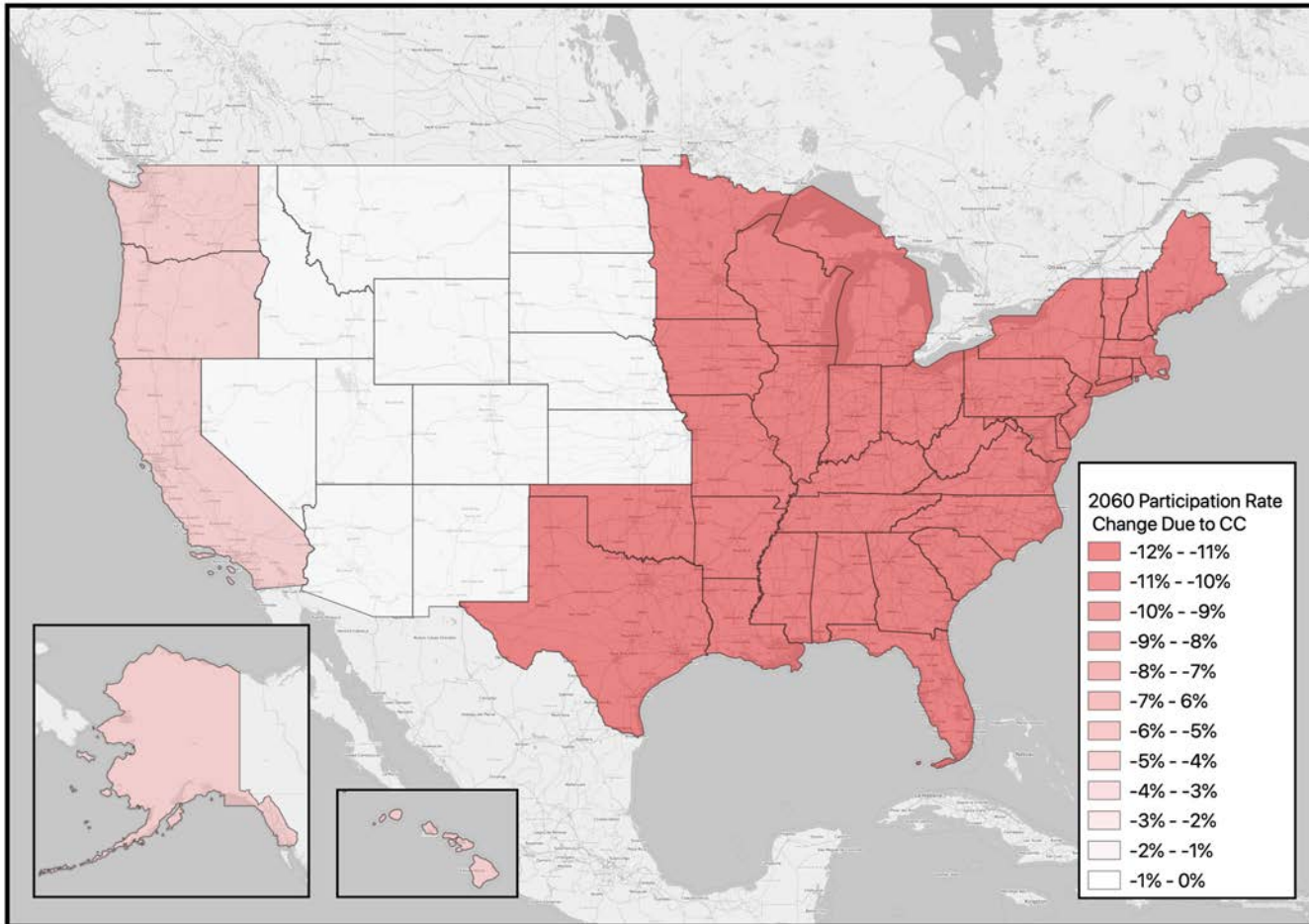
USDA FOREST SERVICE



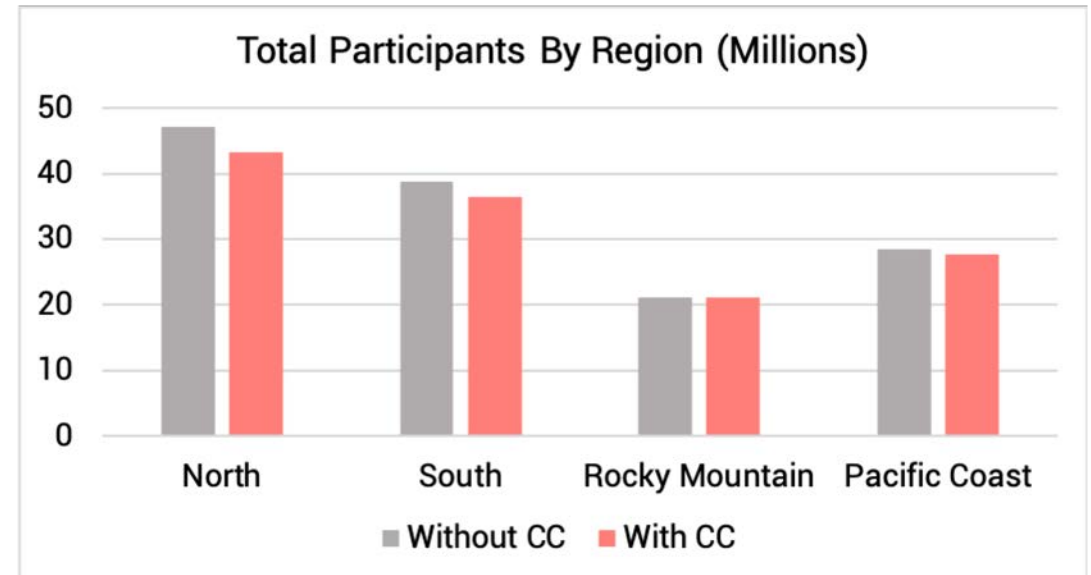
DEVELOPED SITES

GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

USDA FOREST SERVICE

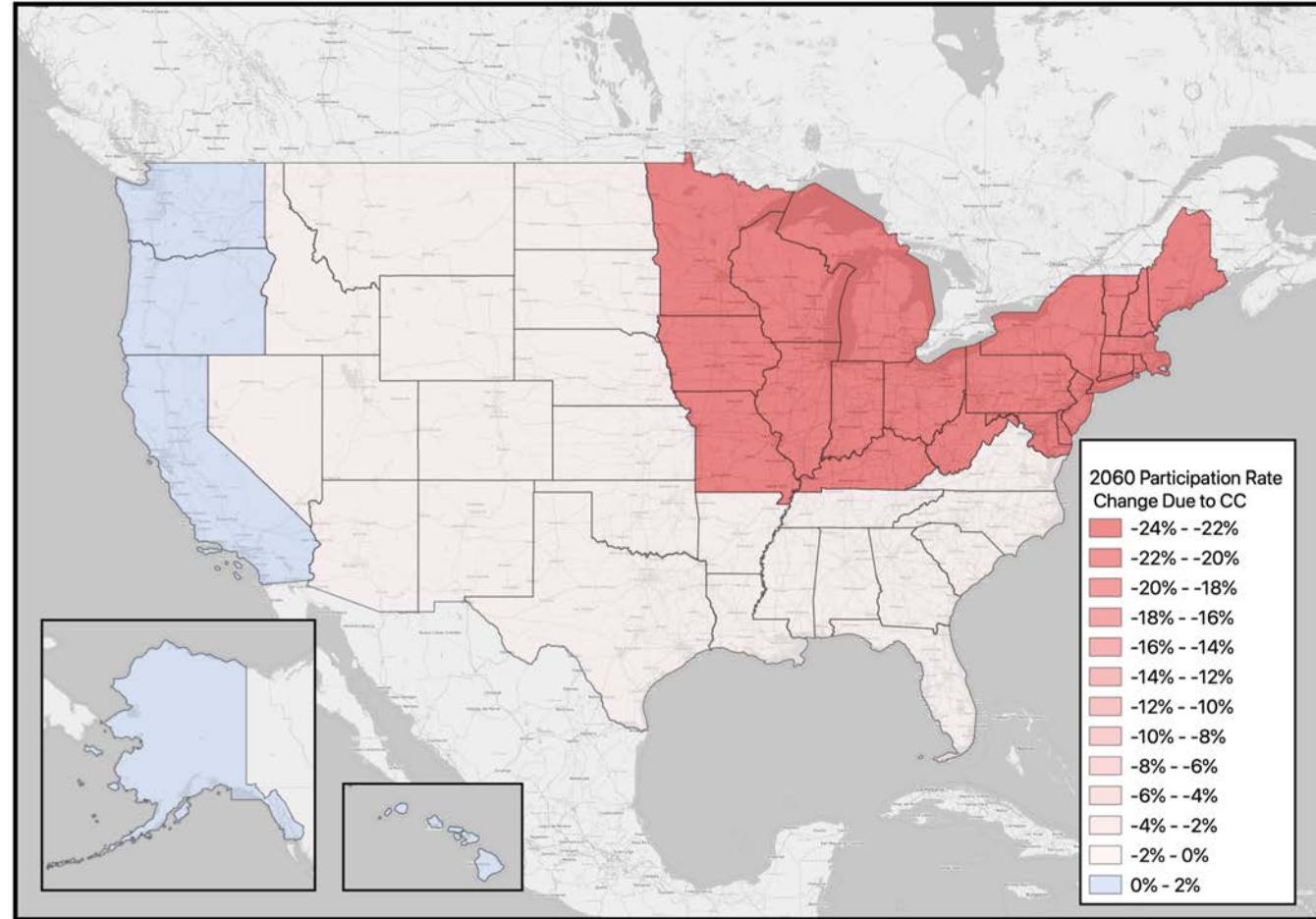


DAY HIKING

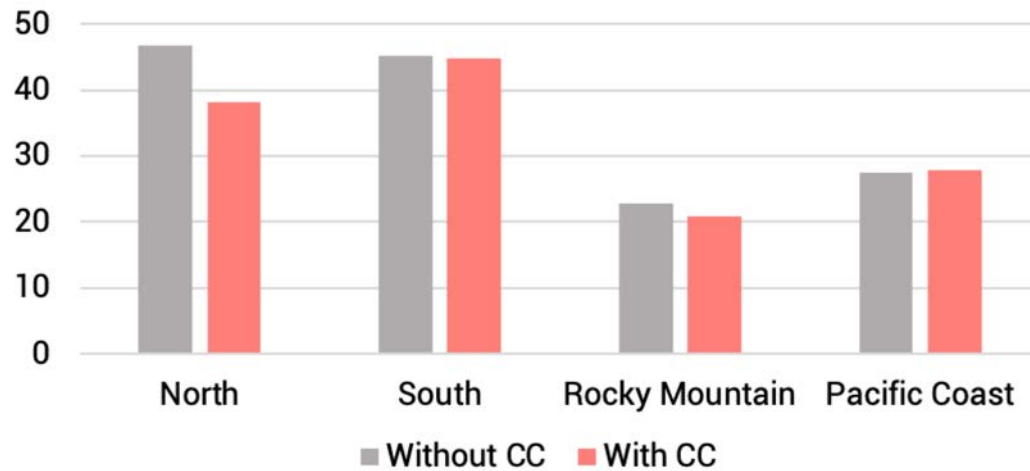


GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

USDA FOREST SERVICE



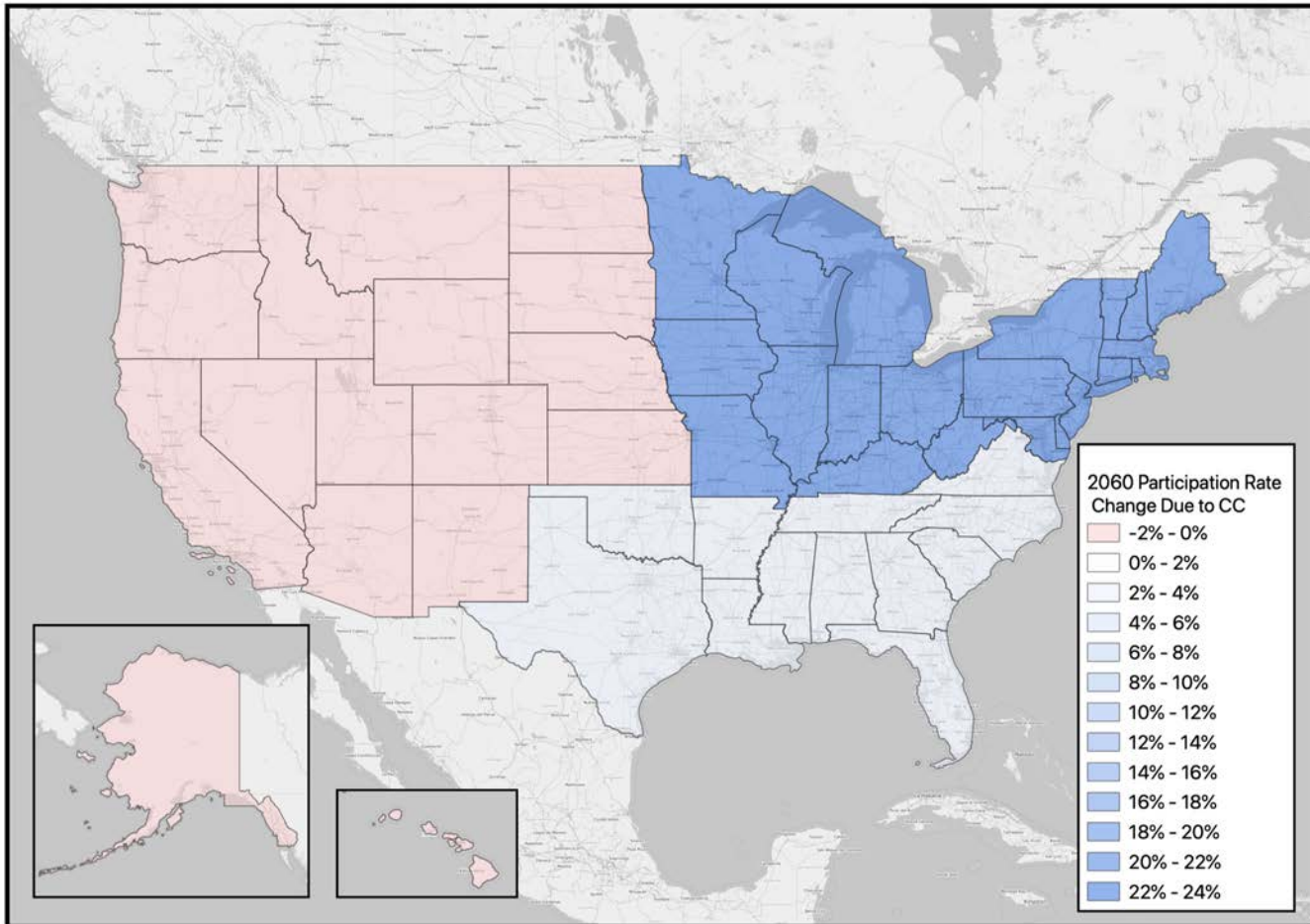
Total Participants By Region (Millions)



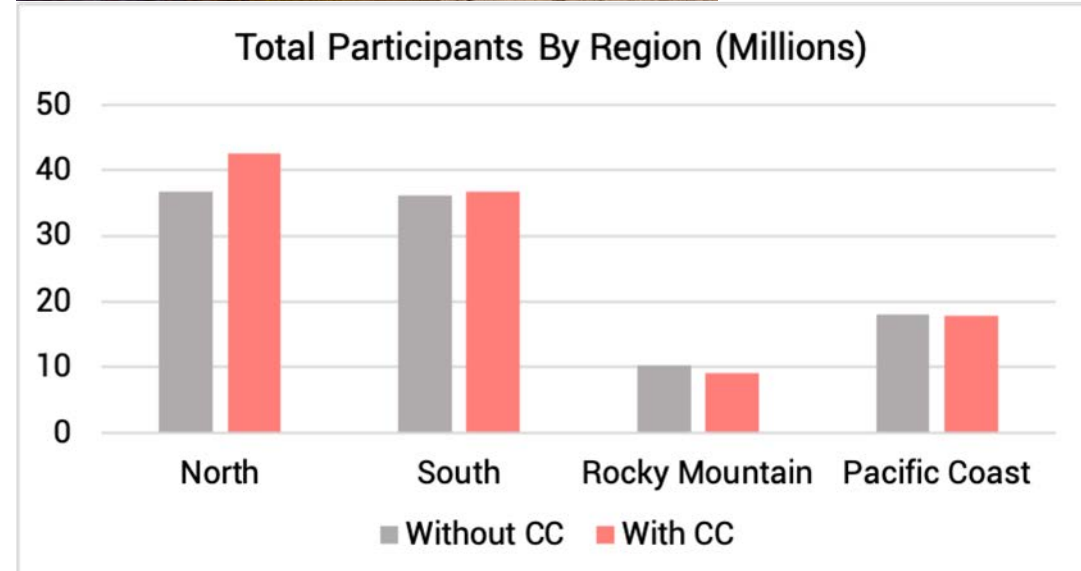
PRIMITIVE AREAS

GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

USDA FOREST SERVICE

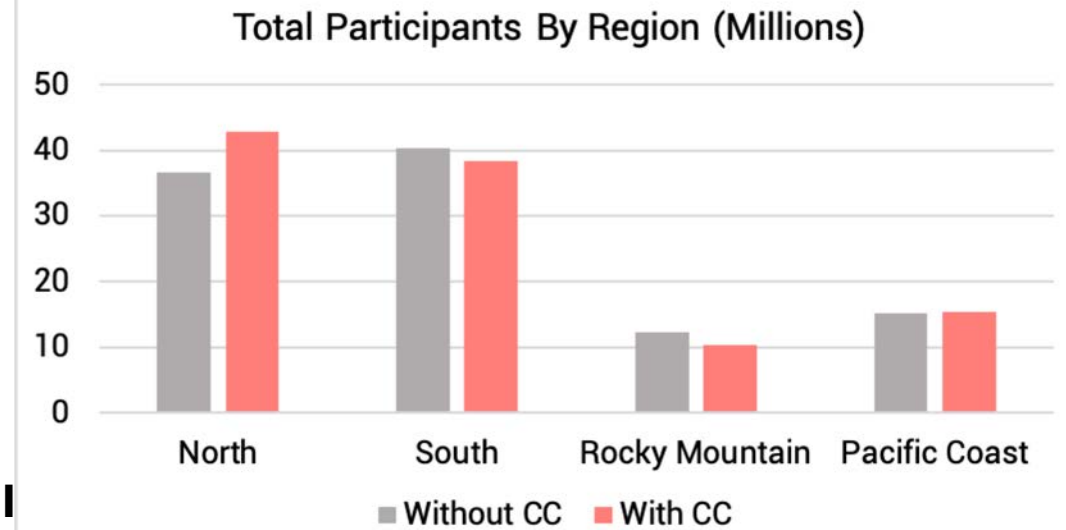
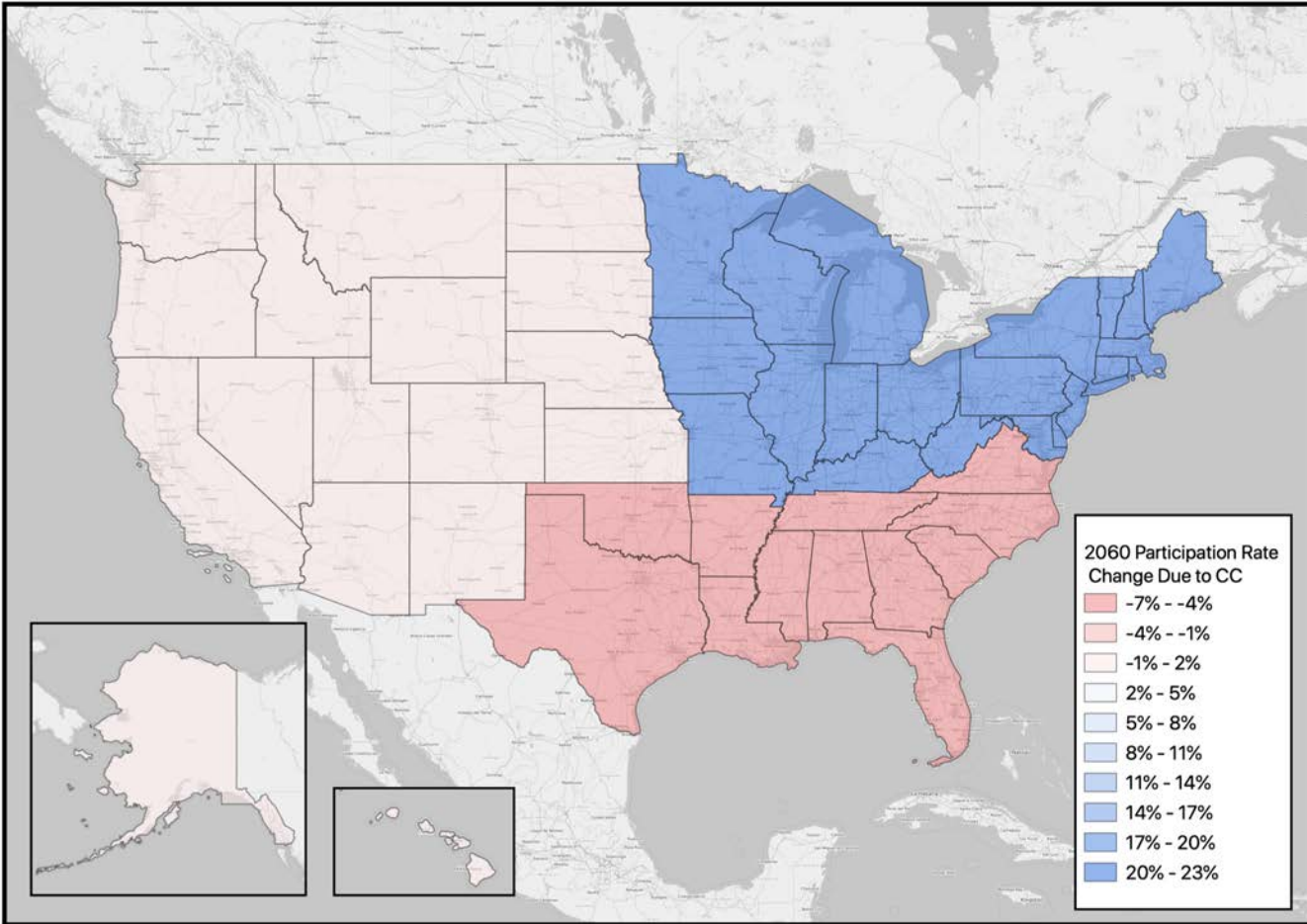


MOTORIZED WATER ACTIVITIES



GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

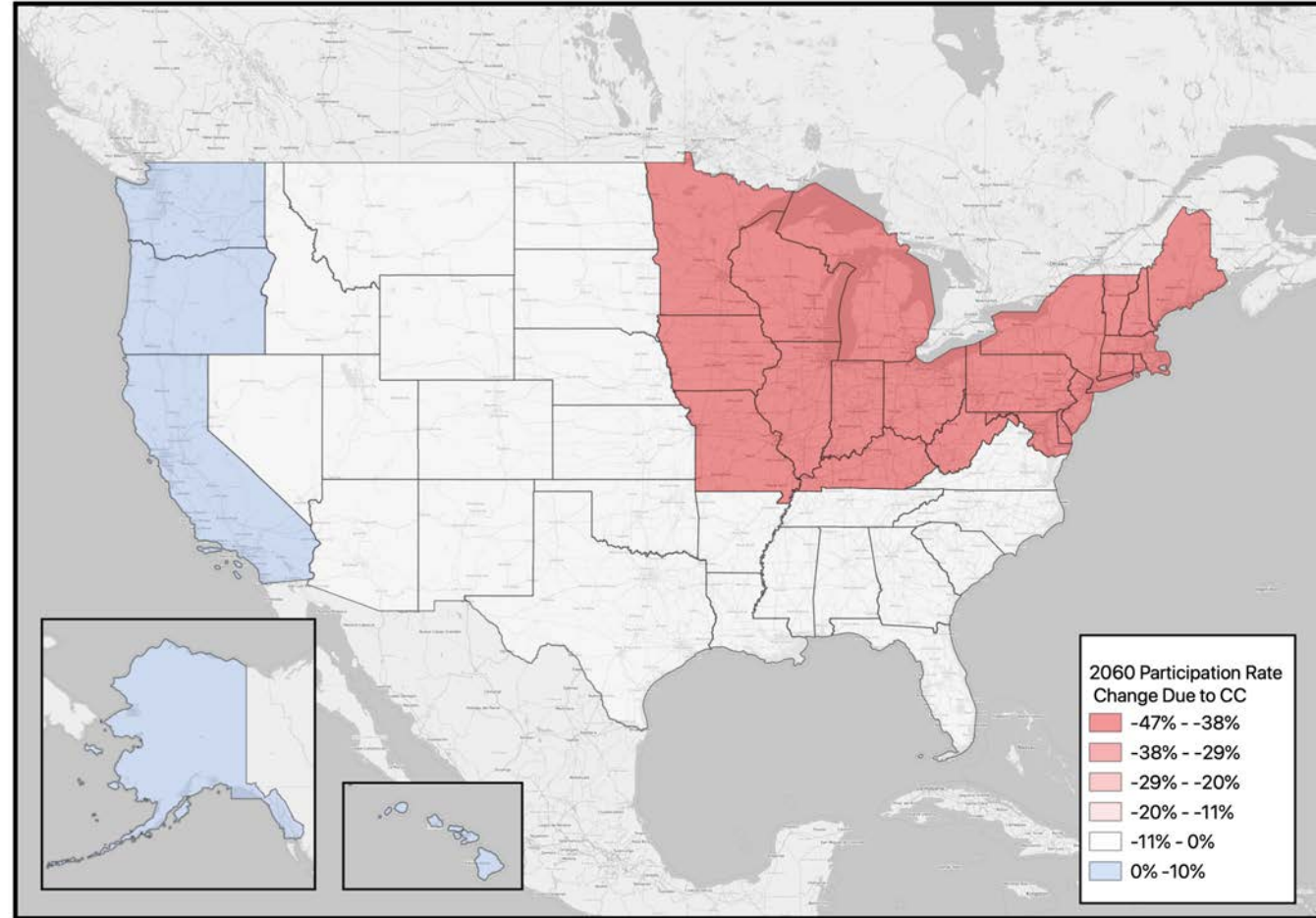
USDA FOREST SERVICE



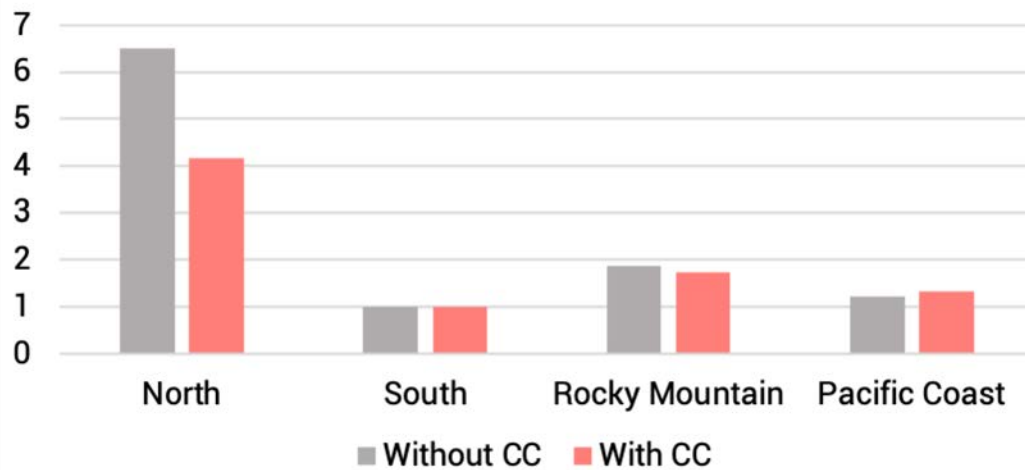
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GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

USDA FOREST SERVICE



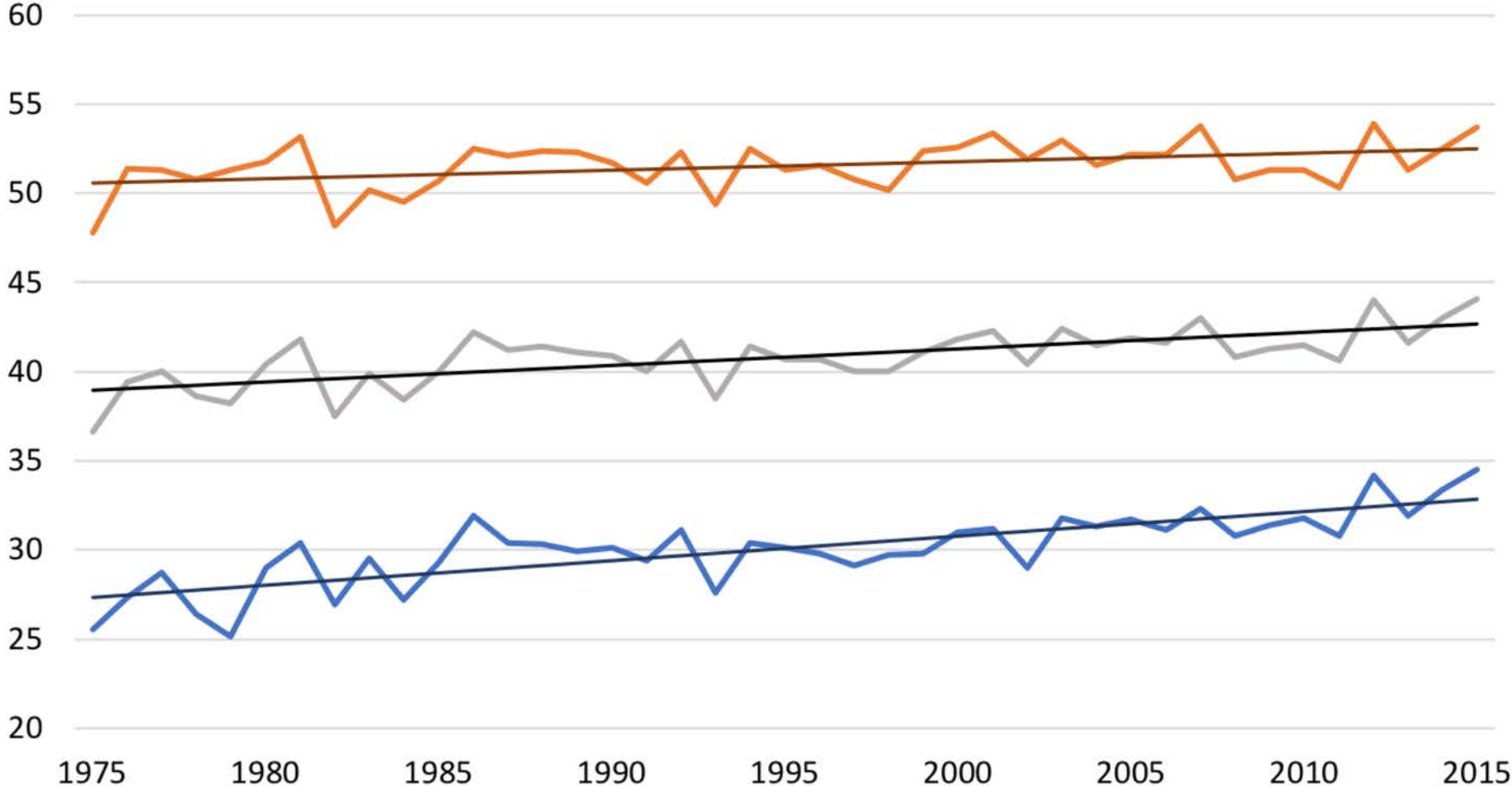
Total Participants By Region (Millions)



UNDEVELOPED SKIING

GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

Average Annual Minimum, Mean, and Maximum Temperatures for
Park City, UT (1975 - 2015)



GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

CASE STUDY: DEVELOPED AND UNDEVELOPED SKIING



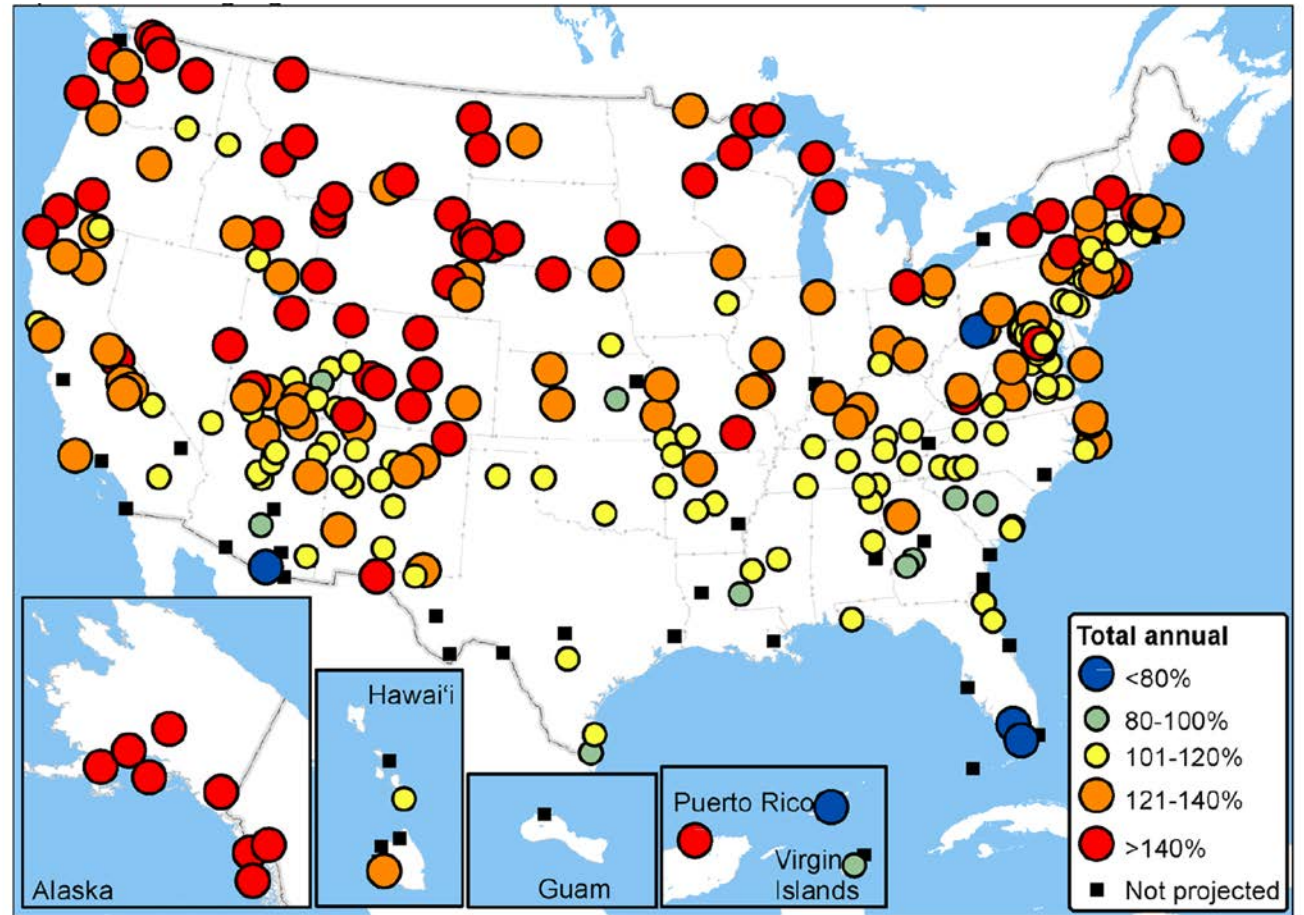
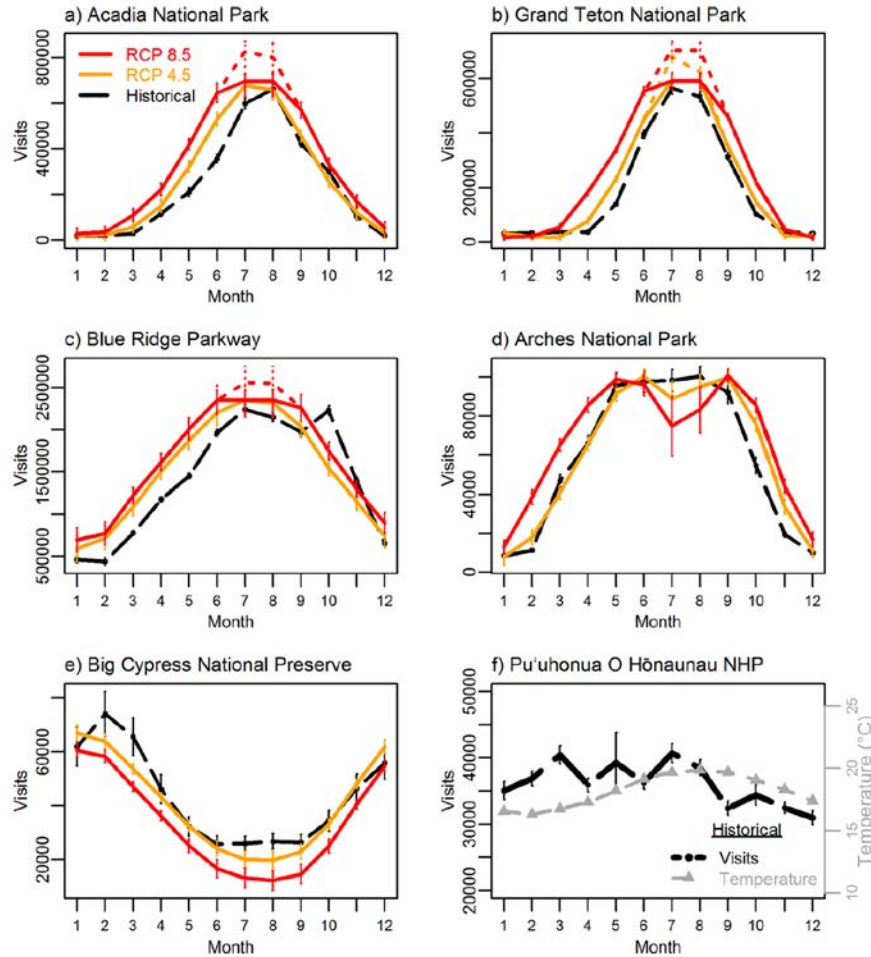
Mountain resorts will have to continue to **DIVERSIFY THE AMOUNT OF WINTER RECREATIONAL OPPORTUNITES** offered.



SNOWMAKING WILL BECOME LESS DEPENDENT as a means to maintain viable snow coverage.

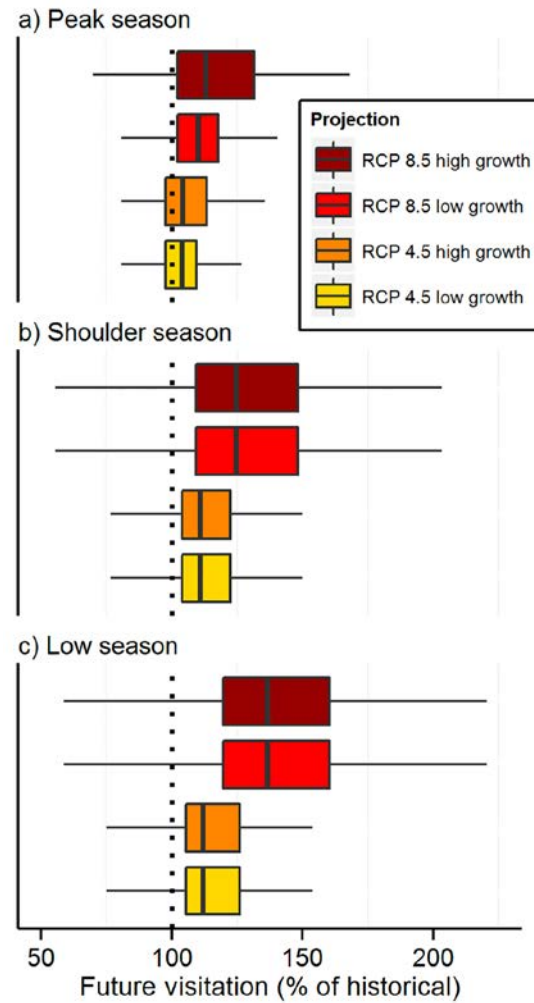
GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

NATIONAL PARK SERVICE



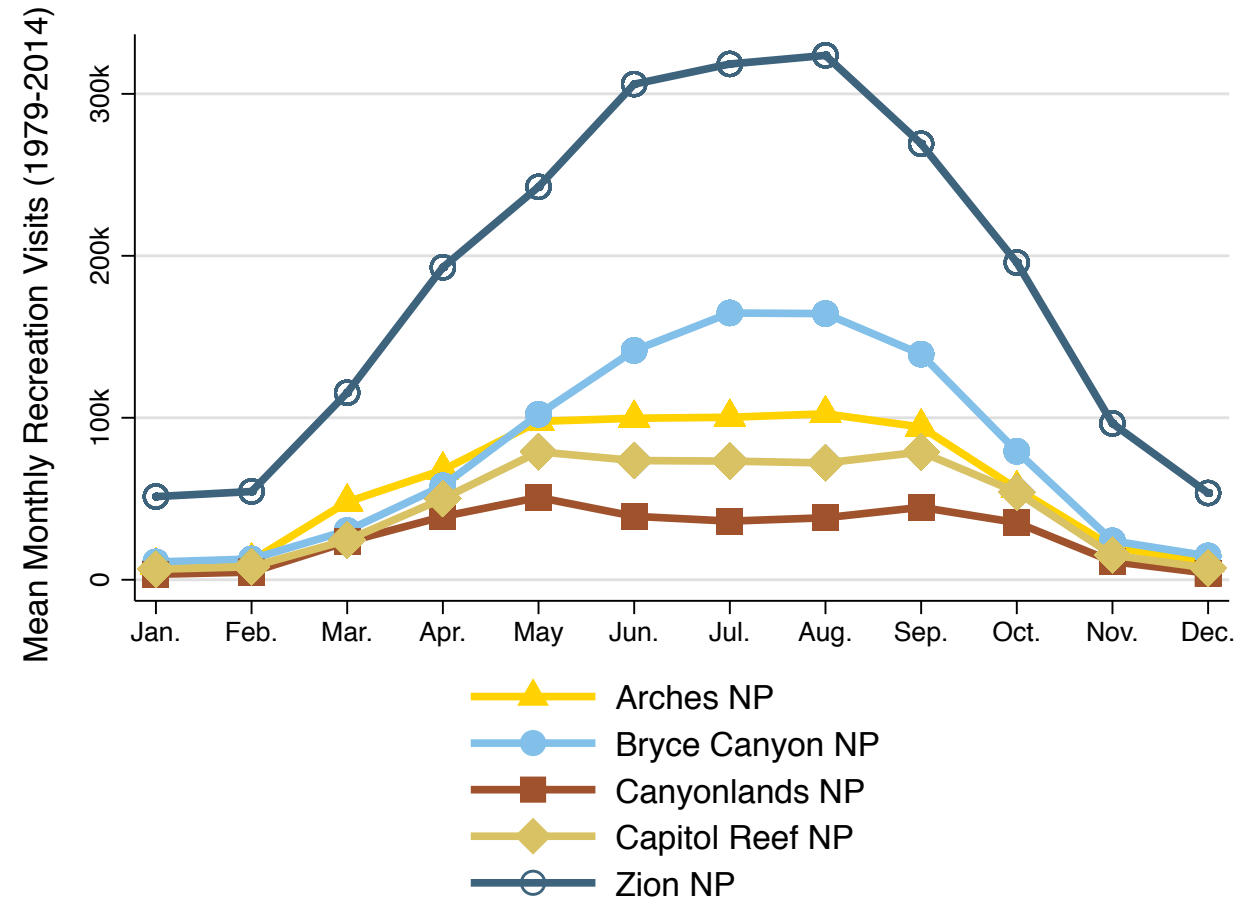
GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

NATIONAL PARK SERVICE



GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

CASE STUDY: DESERT PARK VISITATION

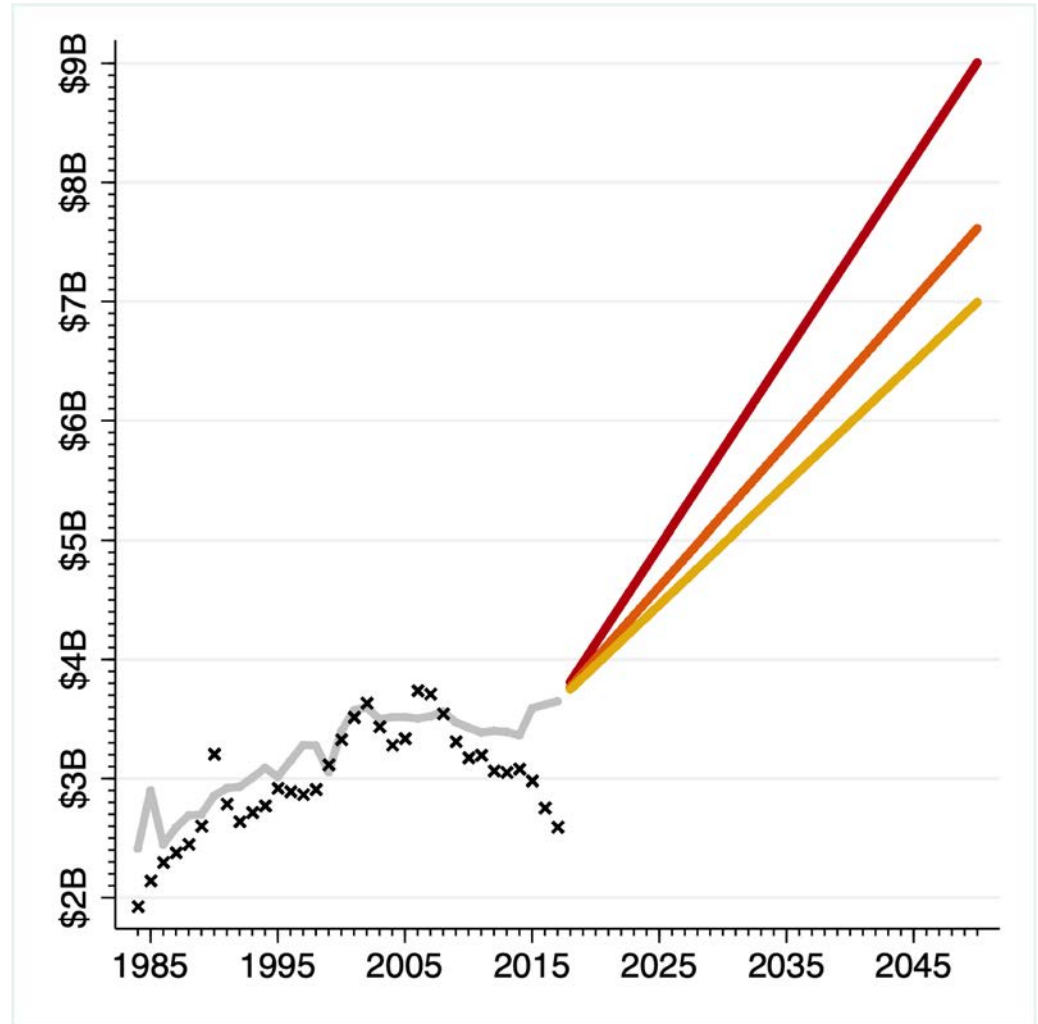
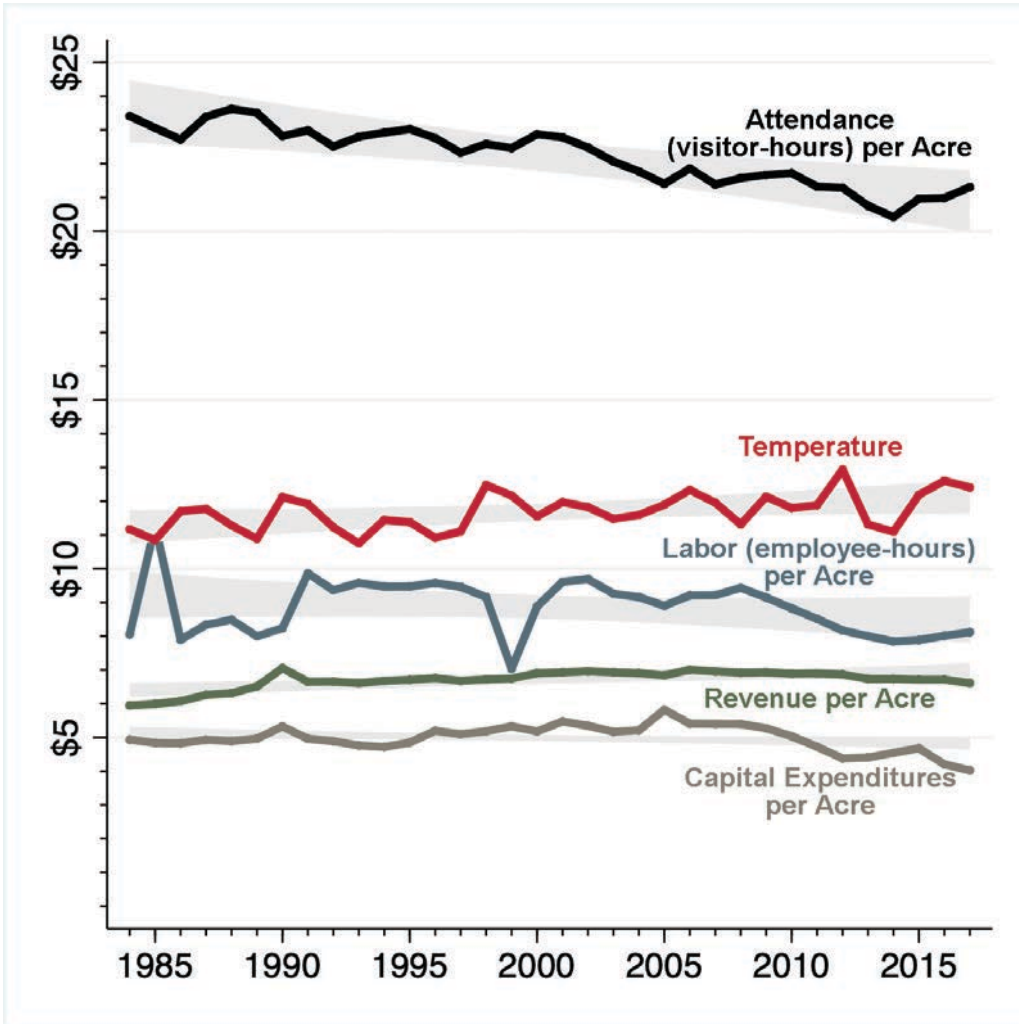


Visitation to most outdoor recreation destinations in southern Utah will **PLATEAU IN THE SUMMER MONTHS**, as average daily temperatures reach 85° F...

...but some destinations show **NO SIGNS OF STOPPING.**

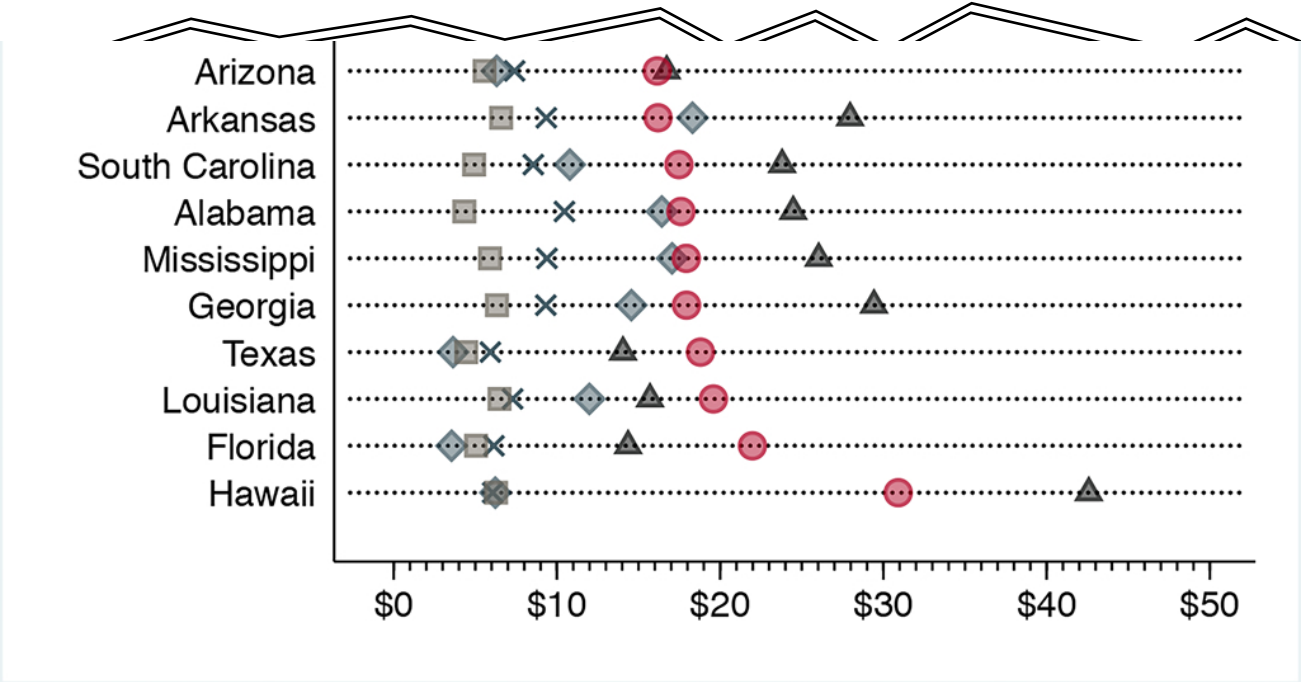
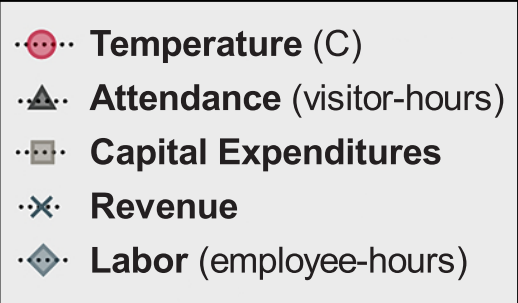
GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

STATE PARK SYSTEMS



GEOGRAPHIC VARIABILITY IN SHIFTS IN PARTICIPATION

CASE STUDY: COASTAL PARK SYSTEMS



GLOBAL CLIMATE CHANGE

Temperature

- Maximum daily
- Minimum daily

Precipitation

- Amount
- Timing
- Phases

Extreme events

- Wildfires
- Floods
- Droughts
- Hurricanes

RECREATION DECISIONS

- Participation**
- Activity and site choice**
- Equipment and investments**
- Frequency and duration**

BIOPHYSICAL IMPACTS

- Vegetation
- Wildlife
- Hydrologic dynamics
- Disturbance events
- Site availability
- Unique features (e.g., glaciers)

PARTICIPATION

MOUNTAIN TOWNS AND CITIES



“I guess poor air quality tends to drive skiers up to the mountain more frequently. The Wasatch offers a great place to **escape** from the air pollution: to get above it.”

PARTICIPATION

MOUNTAIN TOWNS AND CITIES

Good
PM 2.5 = 0 – 12 µg/m³



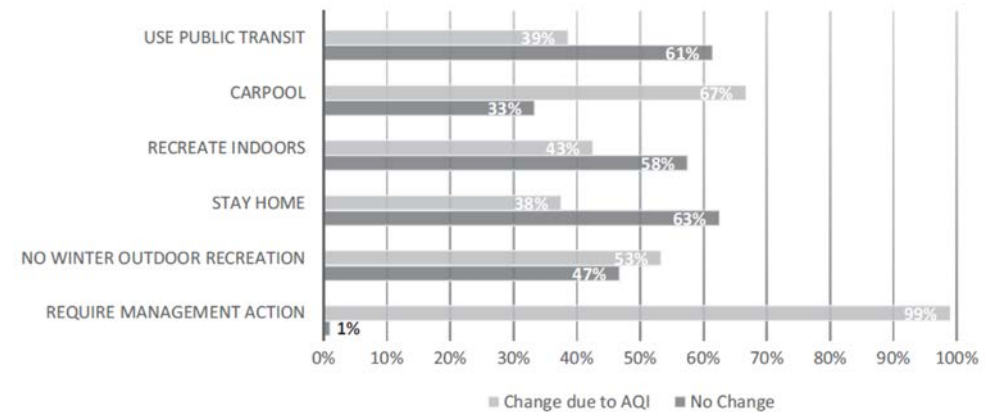
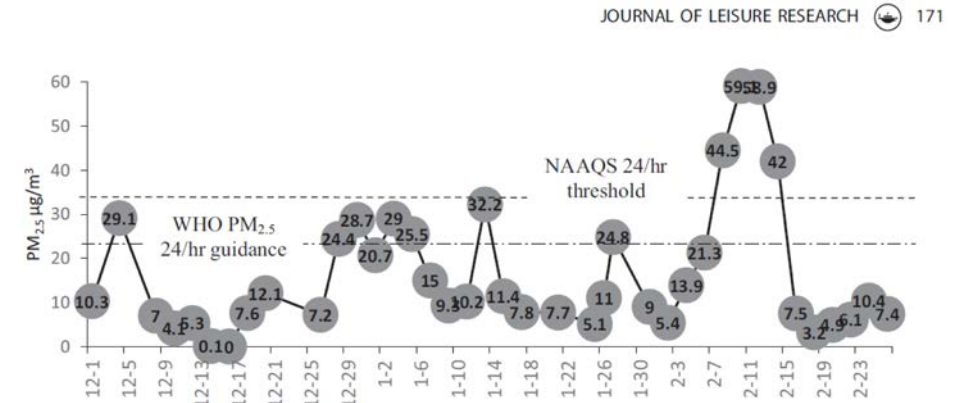
Moderate
PM 2.5 = 12.1 – 35.4 µg/m³



Unhealthy for Sensitive Groups
PM 2.5 = 35.5 – 55.4 µg/m³



Unhealthy
PM 2.5 = 55.4 – 150.4 µg/m³



ACTIVITY AND SITE CHOICE

TEMPERATE PARKS

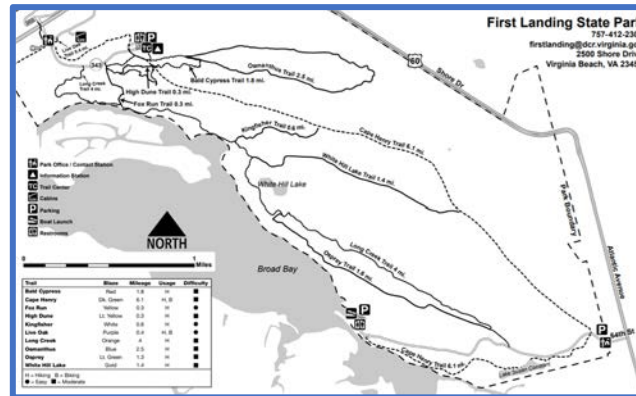


- Decrease the amount of use
- Shift use to northly parks at higher elevations

- Shift participation among the 10 recreation activities included in the study

EQUIPMENT AND INVESTMENTS

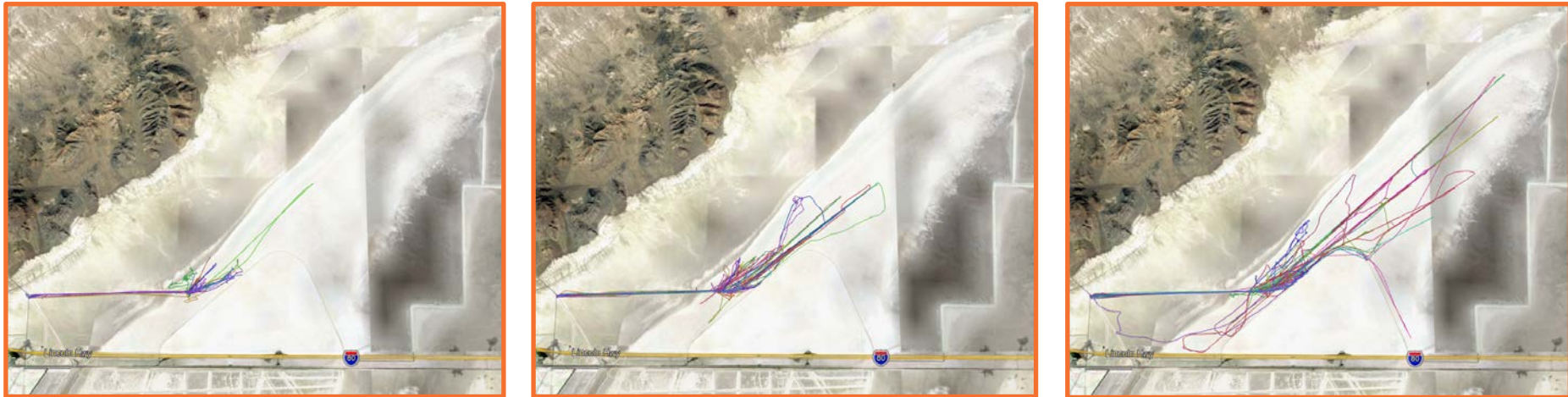
COASTAL RESOURCES



- Protection
 - Seawalls, jetties
 - Living shorelines
 - Beach nourishment
- Accommodation
 - Raise
 - Change structures
 - Retrofit
- Retreat
 - Down-zone
 - Reduce use
 - Reallocate

FREQUENCY AND DURATION

DESERT RESOURCES



Month	Total Distance		Total Time		Time on Road		Time on Salt		Traveled on Road Only
	M _{miles}	SD	M _{minutes}	SD	M _{minutes}	SD	M _{minutes}	SD	
May	8.49 ^a	4.4	42.4 ^a	35.83	30.64 ^a	29.70	8.83 ^a	20.41	64.42%
June	12.01 ^b	6.11	55.02 ^b	30.80	38.24 ^b	24.12	16.78 ^b	16.09	15.53%
July	13.43 ^b	7.57	63.67 ^b	32.11	41.33 ^b	23.33	22.33 ^b	21.15	20.71%
F (2, 264)	13.58**		7.01**		2.93 (p = 0.06)		6.93**		χ² = 143.43** ^

Note. Mean scores with different superscripts within column differ at $p < 0.05$; * $p < 0.05$; ** $p < 0.01$; ^ significance determined by Kruskal-Wallis Test; * $p < 0.05$; ** $p < 0.01$

FREQUENCY AND DURATION

DESERT RESOURCES



Indicators of Quality

Open Space, Natural Views, Photo Opportunities, Avoiding Crowds, Roadless Travel

Racing History

What now?

- **Outdoor recreation professionals will increasingly confront complex climate change scenarios.**
- **Planning for and adapting to an uncertain future is necessary.**
- **Accessing the best available science is important.**



Trift Glacier in 2006



Trift Glacier in 2015

Principles for dealing with change

Principle 1: Begin with managers' needs

- **What are the specific issues we are, or will confront in respect to climate change?**
- **What do we need to know?**
- **When do we need the information?**
- **Where does this information exist?**
- **Who else might be influenced?**
- **Who can we partner with?**

Principles for dealing with change

Principle 2: Give priority to the process as well as the products

- Citizen science projects
- Collaborative meetings (internal and external)
- Engaging new generations of professionals



Principles for dealing with change

Principle 3: Link information providers and users

- **Identify existing information partnerships**
- **Stakeholder gap analysis**
- **Universities and research centers**

Principle 4: Build connections across disciplines and organizations

- **Similarities in mission and policies**
- **Establish new partnerships**
- **Review existing strategies (e.g., NPS CC Action Plan)**

Principles for dealing with change

Principle 5: Enhance institutional capacity

- **Increase flexibility in policies and processes**
- **Establish new practices where necessary**
- **Staff training and development**
- **Scenario workshops to envision possible futures**

Principle 6: Design for learning

- **Adaptive management**
- **Tracking trends**
- **Baseline data is important**
- **Document the process**

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8. J. W. Smith, E. Wilkins, R. Gayle, C. C. Lamborn, Climate and visitation to Utah’s “Mighty 5” national parks. *Tourism Geographies* **20**, 250–272 (2018).
9. J. W. Smith, E. J. Wilkins, Y.-F. Leung, Attendance trends threaten future operations of America’s state park systems. *PNAS*, 201902314 (2019).

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QUESTIONS?

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UPCOMING SORP WEBINARS

Leave No Trace – From Science to Application in Parks and Protected Areas: Strategies for Influencing Visitor Behavior

Speaker: Ben Lawhon, Leave No Trace: Center for Outdoor Ethics

Date: January 15, 12 (mountain)

A New Table

Speaker: Chevon Powell,
Founder Refuge Outdoor Festival

Date: February 12, 12 (mountain)

Sustainable Recreation and Tourism on Public Lands

Speakers: Lee Cerveny, US Forest Service, Pacific Northwest Research Station
Monika Derrien, US Forest Service, Pacific Northwest Research Station
Anna Miller, Institute of Outdoor Recreation and Tourism at Utah State University

Date: March 11, 12 (mountain)



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